


Impacts of Land Use Change on Water Resources - Microsoft Internet Explorer provided by Purdu...

Address <http://www.e> Go Links

Impacts of Land Use Change on Water Resources

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L-THIA
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[Determining Short-term Impacts](#)
The short-term impacts of a change in land use can often be

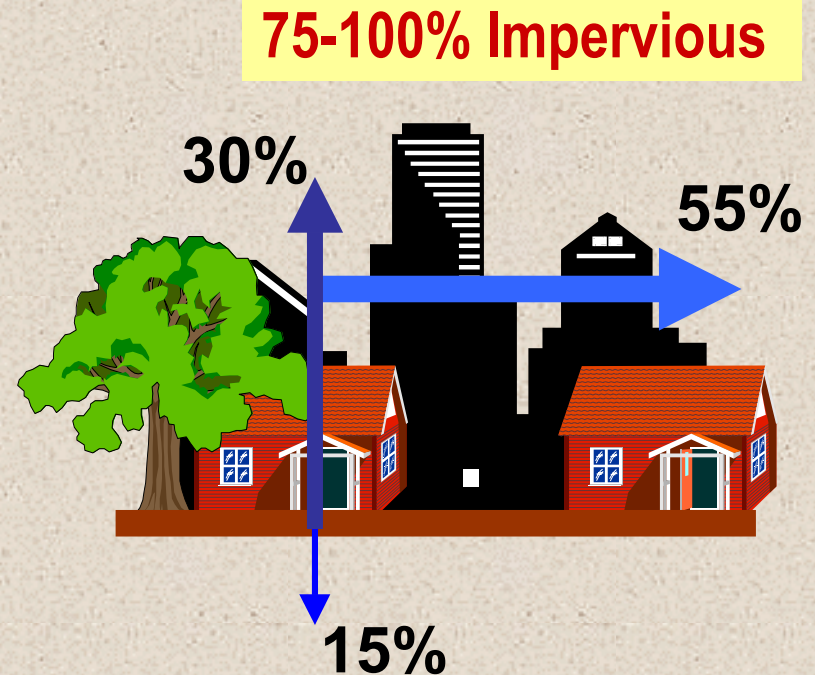
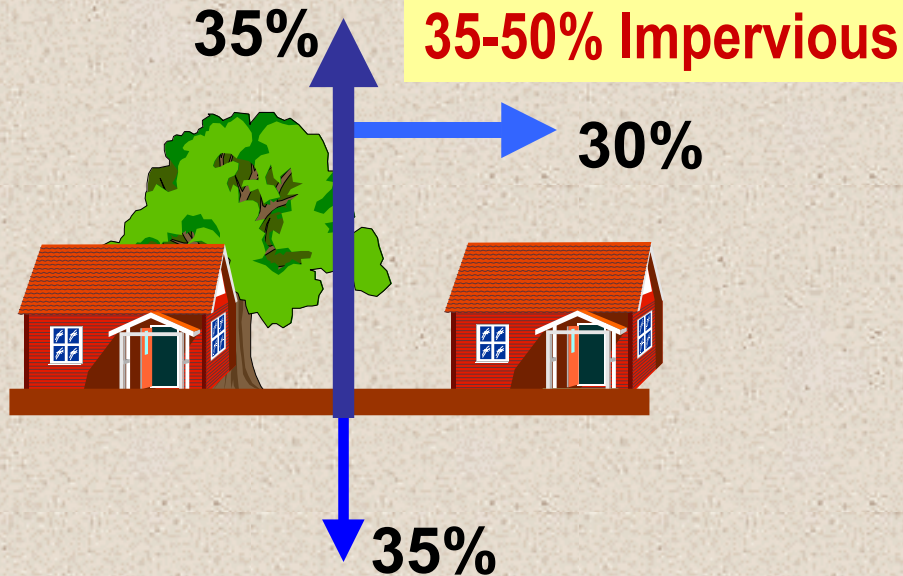
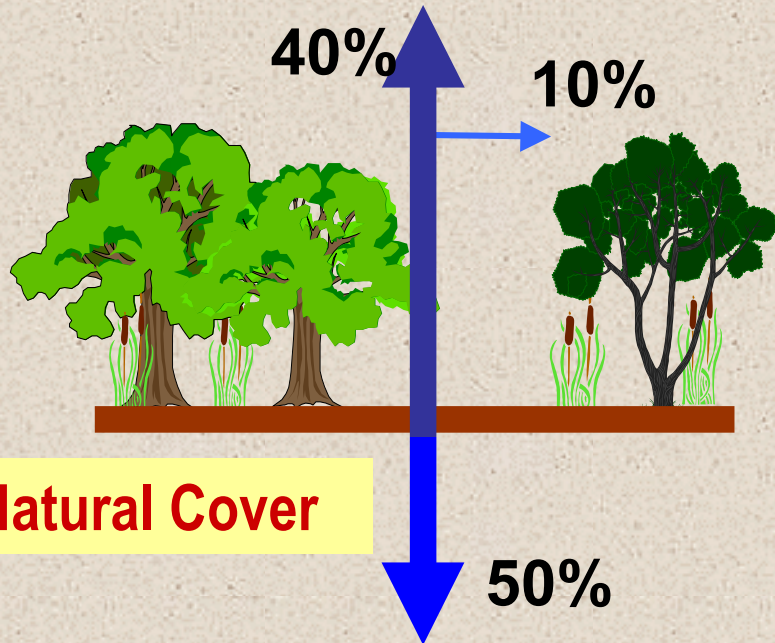
[Determining Long-term Impacts](#)
The long-term impacts of a change in land use can often be seen in the **average**

Internet

**Changing Landscapes:
Anticipating the effects of
local land use decisions.**

**Long-Term Hydrological Impact Assessment
(L-THIA)**

Land Use Decisions Effect Runoff, Recharge, and Water Quality



Rivers Drying Up Rivers Flooding Water Polluted Streets

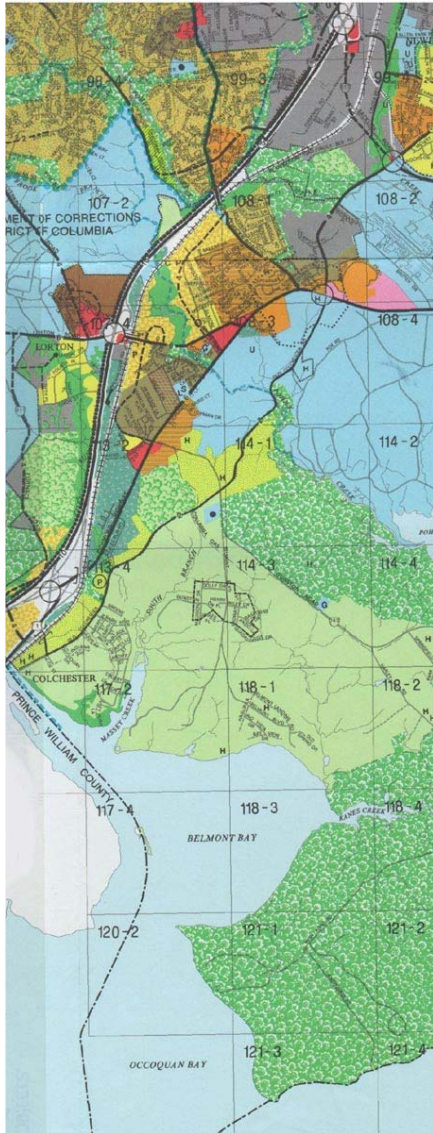


Most communities respond to this with a mix of reactive and proactive strategies, including planning

ry
inking



Planning

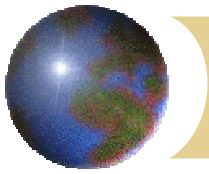


*The most important, large-scale,
proactive step:*

*Where you do it can be just as
important as what you do*

**Multifaceted – so how do
you bring environmental
concerns into this?**

Impact Assessment Tools



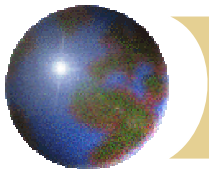
A little history....

Northeast Ohio, 1992: “Our wetlands are failing”

Local Planners: Need model to assess impact of land use change on hydrology.

Reality: Available models were far too data intensive and complex – and getting worse!

The Aim: To develop a user-friendly model using basic available data for land use and soils, in response to the needs of planners and local environmental groups.



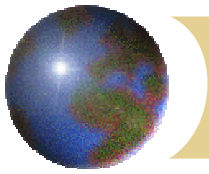
L-THIA

Based on the rainfall – land cover – runoff analysis method already used in many communities (TR55)

Input: Land Use + Soils Information

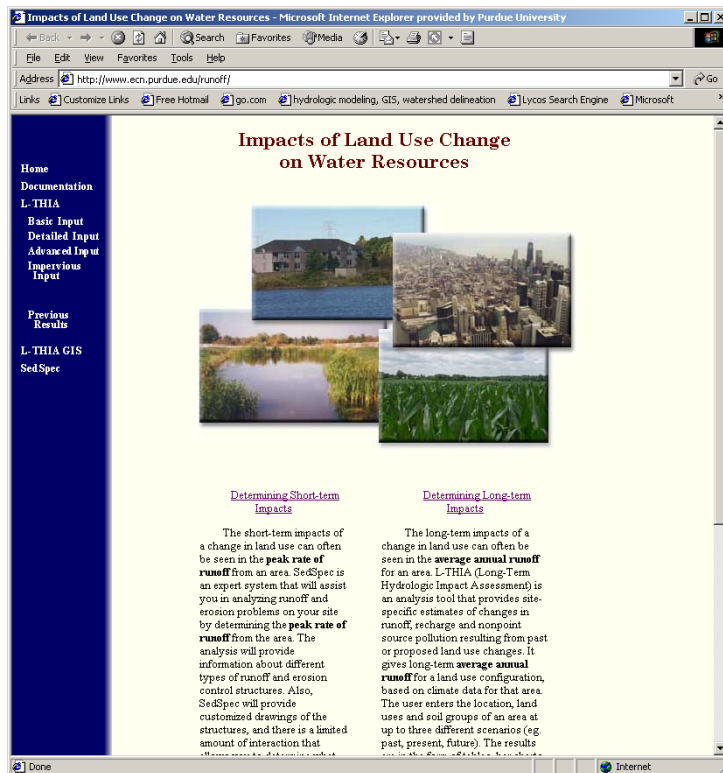
Process: Daily Runoff and Pollutant Loading Calculations (30 years of local rainfall)

Output: Average Annual Runoff and NPS loads for each specific land use pattern



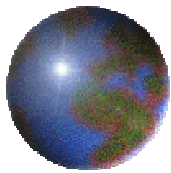
L-THIA

Originally a simple spreadsheet program



Now a web tool
(basic and custom versions)

GIS extension version also
available



✓ Large-Scale Implementation Coming Soon from - IC

L-THIA (Long-Term Hydrologic Impact Assessment) - Microsoft Internet Explorer provided by Purdue...

Local Government Environmental Assistance Network

HOT TOPICS WHAT'S NEW? REGULATORY INFORMATION TOOLS & RESOURCES CALENDAR

Land Use Impacts on Water Quality

As local land use decisionmakers, municipal and county leaders regularly measure the benefits and costs of development proposals. In addition to factors such as the extension of existing infrastructure and the delivery of government services, local officials are beginning to consider the impact that land use changes will have on a community's water quality.

Land use changes can significantly impact groundwater recharge, stormwater drainage, and water pollution. L-THIA (Long-Term Hydrologic Impact Assessment) was developed as an accessible online tool to assess the water quality impacts of land use change. Based on community-specific climate data, L-THIA estimates changes in recharge, runoff and nonpoint source pollution resulting from past or proposed development. As a quick and easy-to-use approach, L-THIA's results can be used to generate community awareness of potential long-term problems and to support planning aimed at minimizing disturbance of critical areas. L-THIA is an ideal tool to assist in the evaluation of potential effects of land use change and to identify the best location of a particular land use so as to have minimum impact on a community's natural environment.

Basic L-THIA Impervious L-THIA GIS L-THIA

Differences Between the Models

- **Basic L-THIA**
Users need only to input their location, soil type, and the type of land use change taking place.
- **Impervious L-THIA**
Allows users to input the percentage of impervious cover of different land uses.
- **GIS L-THIA**
Enables users to download an ArcView GIS version of L-THIA for PCs.

LGEAN - Microsoft Internet Explorer provided by Purdue University

Local Government Environmental Assistance Network

HOT TOPICS WHAT'S NEW? REGULATORY INFORMATION TOOLS & RESOURCES CALENDAR

L-THIA Basic Model

Introduction Location Land Use Change Results Interpreting the Results

Step Three

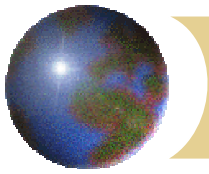
Land Use Change Scenarios

Users must identify the current land use for a specific area, and can describe up to two land use change scenarios. Users can select as many land use descriptions as necessary to describe the current land use or land use change scenarios. Users must also describe each land use description's size and soil type. Size can be entered in either acres, square miles, hectares, or square kilometers. If unknown, soil types can be determined using the link below to GIS maps of your region. **Important:** The total area of the current land use and each of the land use change scenarios must be equal before L-THIA can run.

Area will be entered in: acres

Land Use ? (Use as many as necessary)	Soil Type ? Check Map	Area ?		
		Current	Scenario 1	Scenario 2
SELECT LAND USE	A			
SELECT LAND USE	A			
SELECT LAND USE	A			
SELECT LAND USE	A			
SELECT LAND USE	A			
SELECT LAND USE	A			
SELECT LAND USE	A			
SELECT LAND USE	A			
SELECT LAND USE	A			
SELECT LAND USE	A			
Total Area:		0	0	0

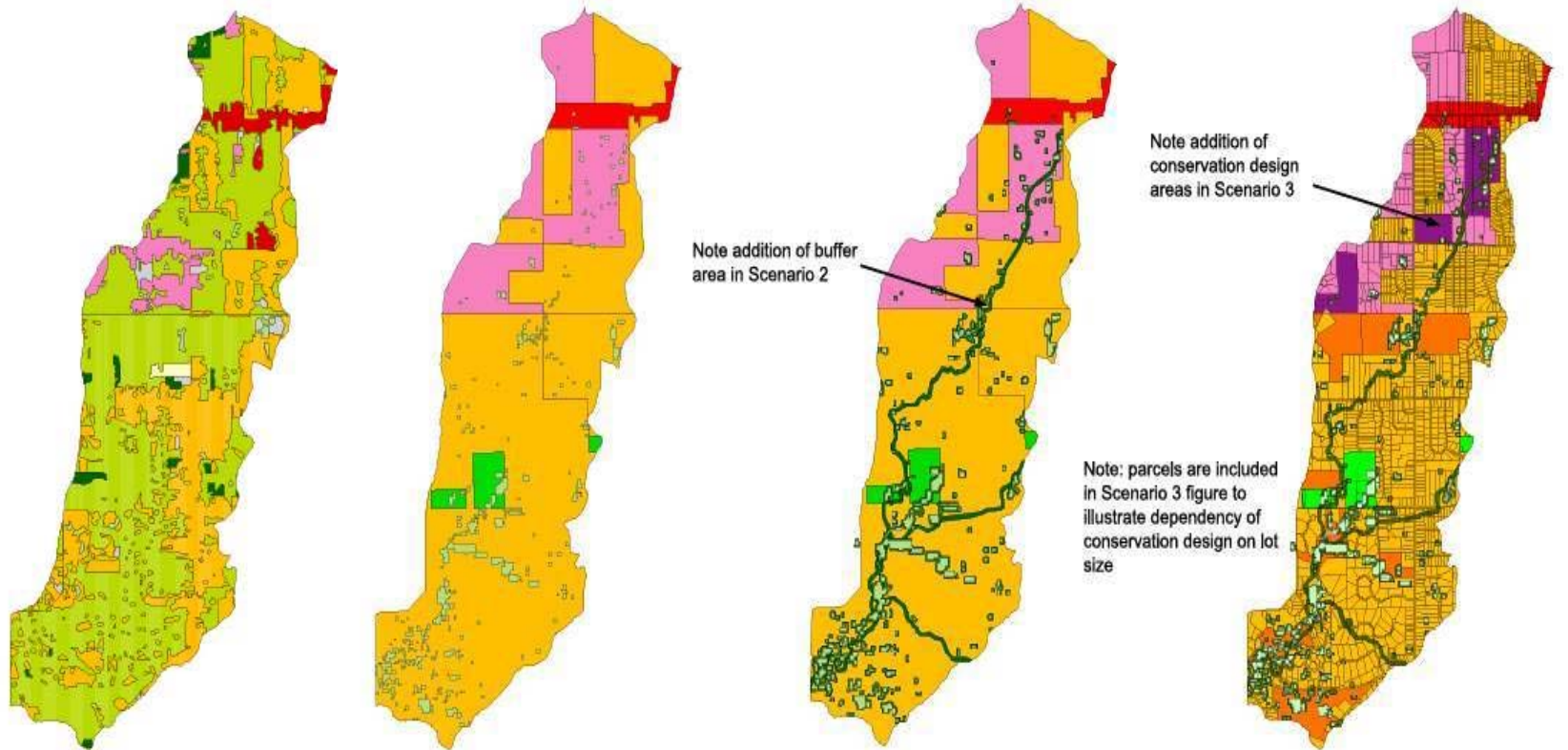
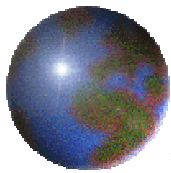
L-THIA Home Previous Next



Example Applications of L-THIA

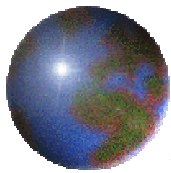
Impacts Assessment for:

- proposed land use change and wetland hydrology.
- residents downstream of a proposed land use change.
- tourism / agriculture transition impacts on a coastal watershed, Barbados.
- past and future land use change in an urban-rural fringe watershed, including impact fee assessment.
- Watershed scale implications of land use change for NPS pollution

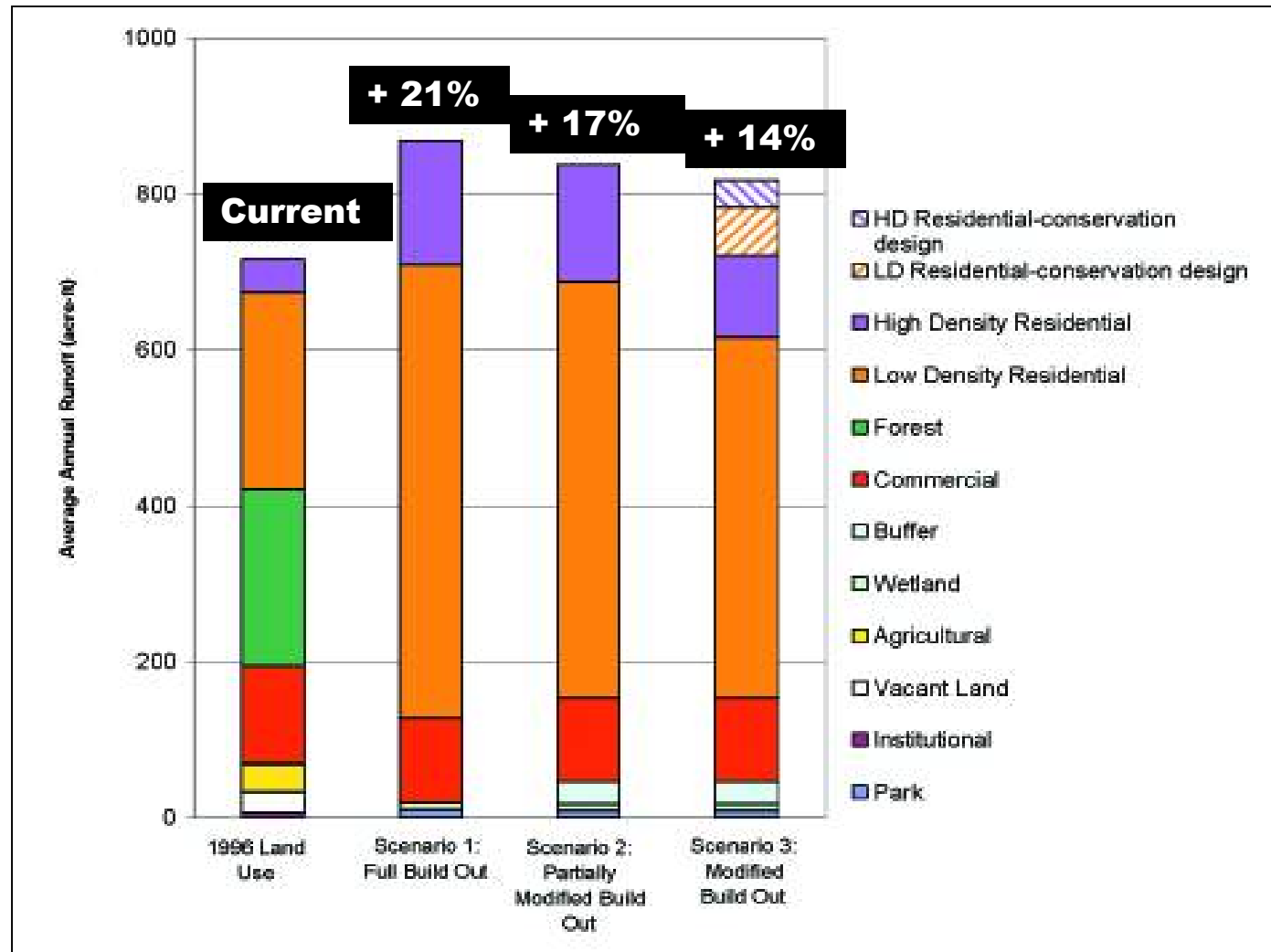


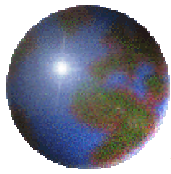
Example: Chagrin River
Watershed Partners,
Griswold Creek Watershed

Land Use	
■	Agriculture
■	Forest
■	Wetland
■	Industrial
■	Wetland/Riparian Buffer
■	Commercial
■	Institutional
■	High Density Residential
■	Low Density Residential
■	HD Residential-conservation design
■	LD Residential-conservation design
■	Vacant land



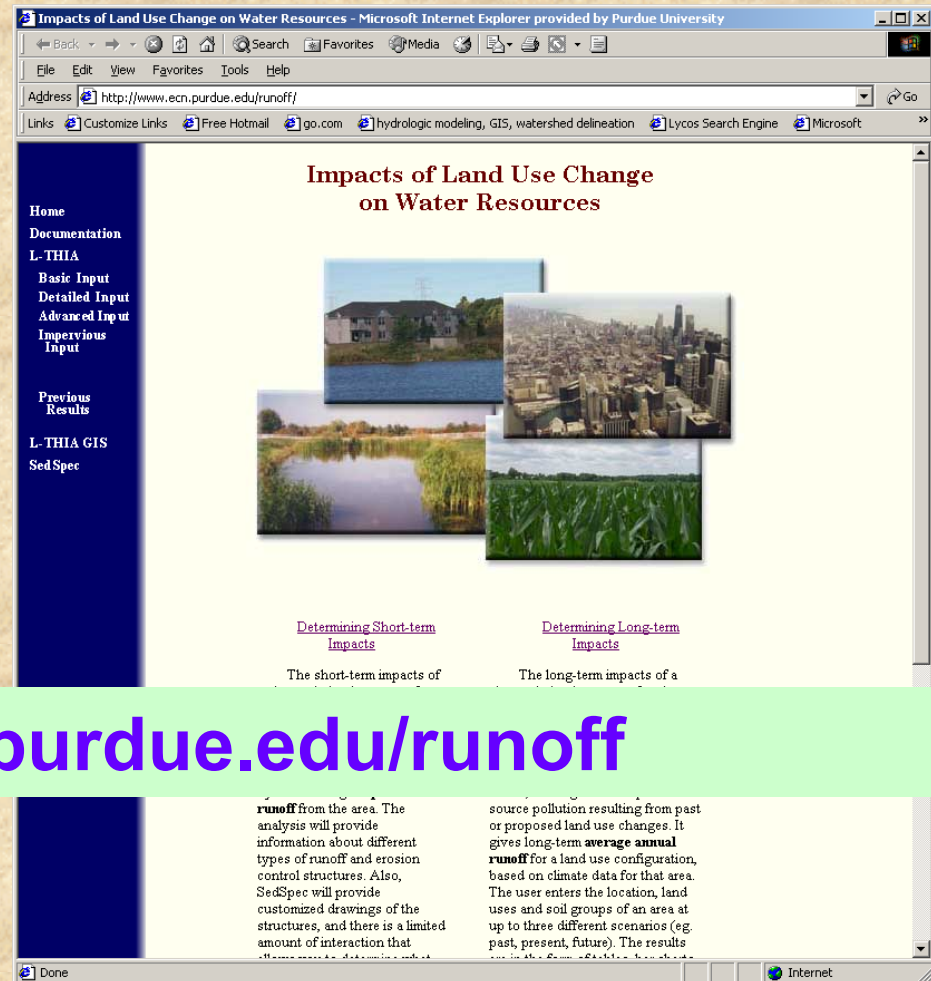
Proposed approaches would reduce but not eliminate the impact



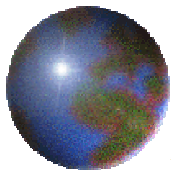


So how do you do it?

✓ L-THIA Web



<http://www.ecn.purdue.edu/runoff>



Run L-THIA from Text Input form

✓ Land use and hydrologic soil group selection

✓ New Development?
This is all in the stormwater plan

L-THIA Basic Input - Microsoft Internet Explorer provided by Purdue University

Address <http://pasture.ecn.purdue.edu/~watergen/owls/outputfig/wdcjy8621>

L-THIA Basic Input

- Name to identify output: wdcjy8621
- State : Wisconsin
- County : Brown
- Area in : acres

LAND USE	HYD. SOIL GROUP	1	2	3
Agricultural	A	2.4		
Agricultural	B	140.0		
Low Density Residential	B	0.9		
Grass/Pasture	A	9.1		
Grass/Pasture	B	97.8		
Forest	A	5.1		
Forest	B	184.0		
SELECT LANDUSE	A			
SELECT LANDUSE	A			
	A			
	A			
	A			
Total Area		439.4	0	0

SCENARIO 1 SCENARIO 2 SCENARIO 3

RUN L-THIA

✓ Output name

✓ State

✓ County

✓ Area unit

✓ Area input

✓ Click Run L-THIA

Tables and charts for interpretation

L-THIA output - Microsoft Internet Explorer provided by Purdue University
 File Edit View Favorites Tools Help Address http://pasture.e

L-THIA OUTPUT

Scenario Name : wdcjy8621
 Total area : 439.4 acres
 State : Wisconsin
 County : Brown

Link To [GIS RAINFALL DATA](#) Text File

Average Annual Runoff Volume for SCENARIO 1

Land Use	Hydrologic Soil Group	Area (acres)	Average Annual Runoff Volume (acre-ft)
Agricultural	A	2.4	0.11
Agricultural	B	140.0	19.63
Agricultural	B	0.9	0.07
Agricultural	B	9.1	0.03
Pasture	B	97.8	3.57
Forest	A	5.1	0.00
Forest	B	184.0	3.51
Total Annual Volume (acre-ft)			26.95
Average Annual Runoff Depth (in)			0.73

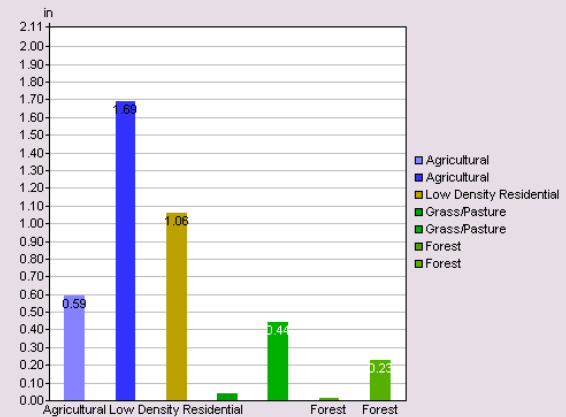
Runoff Depth For Hydrologic Soil Group And Landuse Combination

Land Use	Hydrologic Soil Group	Curve Number	Runoff Depth (in)
Agricultural	A	64	0.59
Agricultural	B	75	1.69
Low Density Residential	B	70	1.06
Grass/Pasture	A	39	0.04
Grass/Pasture	B	61	0.44
Forest	A	30	0.01
Forest	B	55	0.23

Average Annual Rainfall Depth (in)

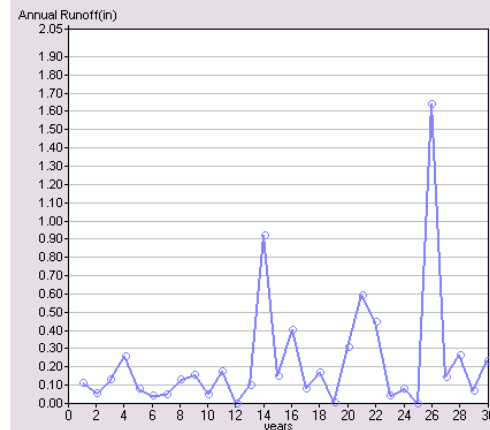
32.15

Runoff Depth



Untitled Document - Microsoft Internet Explorer provided by Purdue University

Annual Variation



Close

Print Results

javascript:window.open("npsbar0.html", "width=600,height=500,menubar=yes,resizable=yes,left=0

Internet

Run L-THIA : Brown County, WI

But What do the Numbers Mean?

More Information - Microsoft Internet Explorer provided by Purdue University

File Edit View Favorites Tools Help Address <http://www.ecn.purdue.edu/runoff/> Go Links

What Can I Do?

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Strategic Land Use Management Techniques to Minimize the Impact of Change

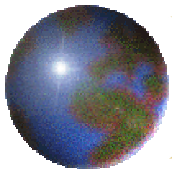
[Learn more](#)

Analyzing Results

- Retrieving output from past model runs
- [Interpreting model results](#)
- [Case Studies](#)

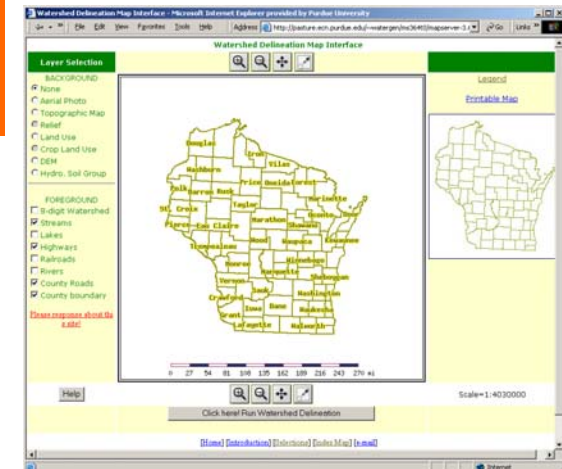
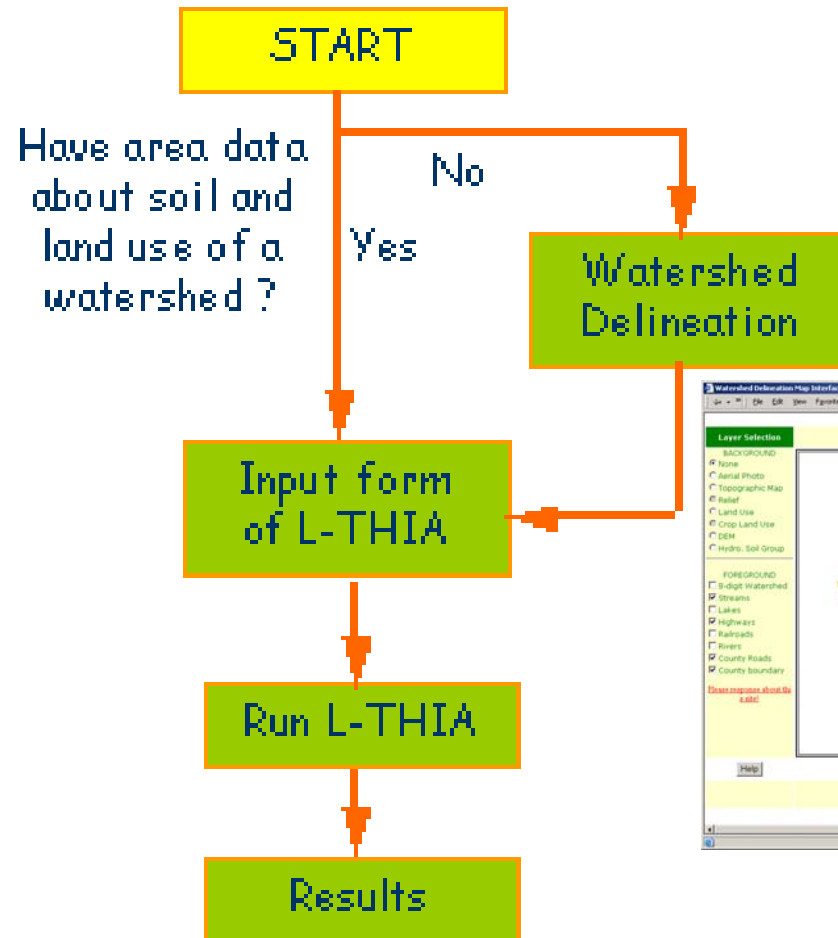
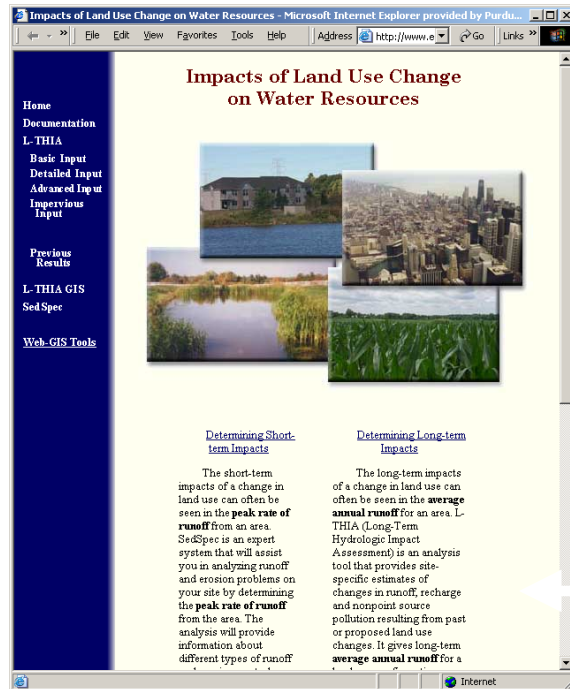
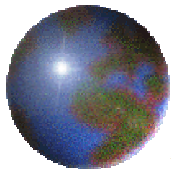
[Definition and Cost Estimates of Urban Best Management Practices](#)

Internet

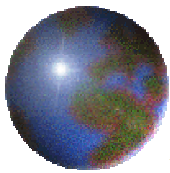


Example Analysis:

Anywhere you like, WI



What if I don't have Land Use and Soils Data?



Web - Microsoft Internet Explorer provided by Purdue University

Click Here

HYMAPS-OWL

Watershed Delineation: Web-GIS tools for Spatial Hydrologic Analysis

L-THIA

Long-Term Hydrologic Impact Assessment

ICMA

LGEAN: L-THIA

Short-term Runoff Tools

Sediment and Erosion Control Planning, Design and Specification Information and Guidance

Wellhead Protection Area

Web-based Wellhead Protection Area Defining Tool

WWW-NAPRA

Web-based National Agricultural Pesticide Risk Analysis

CAAGIS

Center for Advanced Applications in GIS, Ag. and Bio. Engineering, Purdue University

Urban BMPs

Web-based Preliminary Tool for Total Maximum Daily Loading

PURDUE UNIVERSITY

PURDUE UNIVERSITY AGRICULTURAL AND BIOLOGICAL ENGINEERING

For more information, please Contact [Bernard A. Engel](#) and [Jin-Yong Choi](#)

Web-GIS - Watershed Delineation - Online Digitizing

For watershed delineation, hydrologic data preparation and online digitizing to all land use and hydrologic soil group information for any area you draw using the online digitizing applet in Indiana, USA, in real time within your WWW browser.

Click Here

Click Here

Select your state

Indiana

Click Here

Wisconsin : This is a trial version.

Other states in the Mid-west area are under processing and will be added. (Illinois, Ohio, Michigan, Minnesota, etc)

Programmed by Bernard A. Engel and Jin-Yong Choi.

Data processed and prepared by Larry Theller in CAAGIS (Center for Advanced Applications of GIS)

PURDUE UNIVERSITY

Agricultural & Biological Engineering

Once you have obtained a watershed using watershed delineator and online digitizing tool you can:

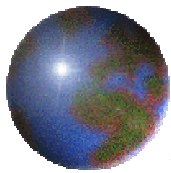
- * Estimation of **impervious area** of your watershed
- * Run **L-THIA** (Long-Term Hydrologic Impact Assessment) model for runoff and nonpoint source pollution loading
- * Run **SedSpec** (Sediment and Erosion Control Planning, Design and SPECification Information and Guidance Tool)
- * After processing, you can also **download** the watershed boundary, land use and hydrologic soil group maps onto your computer, and use with desktop GIS tools like ArcView. (Refer to the download page)

Programmed by Jin-Yong Choi & Bernard A. Engel, and data supported by Larry Theller CAAGIS (Center for Advanced Application of GIS)

Agricultural & Biological Engineering Department, Purdue University
ABE Bldg. 225 S. University Street, West Lafayette, IN 47907-2064
This tools have been developed with support from USEPA, USDA and US Army CER

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<http://pasture.ecn.purdue.edu/~watergen>



Watershed Delineation Map Interface - Microsoft Internet Explorer provided by Purdue University

Address: <http://pasture.ecn.purdue.edu/~watergen/ms364t0/mapserver-3.6.4/n>

Watershed Delineation Map Interface

Layer Selection

BACKGROUND

- ☒ None
- ☐ Aerial Photo
- ☐ Topographic Map
- ☐ Relief
- ☐ Land Use
- ☐ Crop Land Use
- ☐ DEM
- ☐ Hydro. Soil Group


FOREGROUND

- ☐ 8-digit Watershed
- ☒ Streams
- ☐ Lakes
- ☒ Highways
- ☐ Railroads
- ☐ Rivers
- ☒ County Roads
- ☒ County boundary

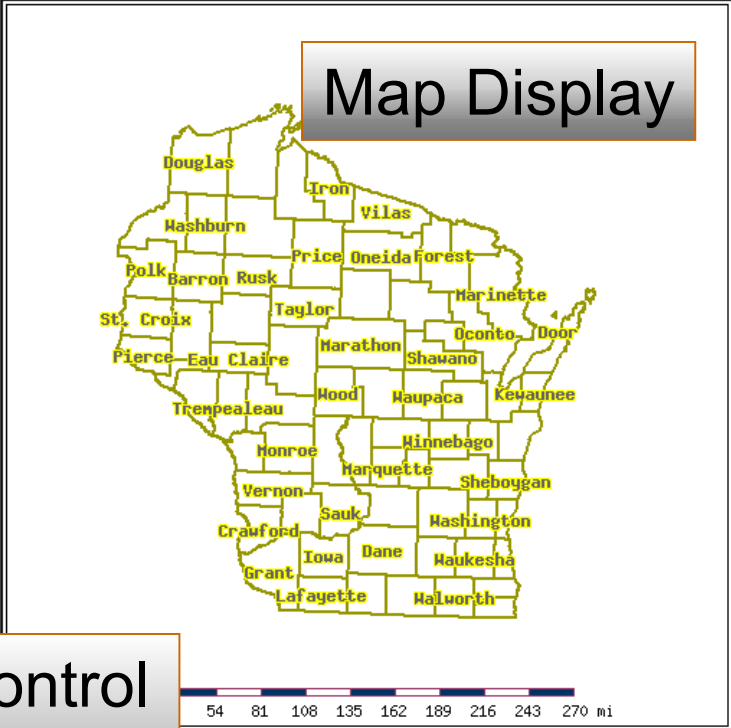
[Please response about this site!](#)

Legend

[Printable Map](#)



Map Display



54 81 108 135 162 189 216 243 270 mi

Scale=1:4030000

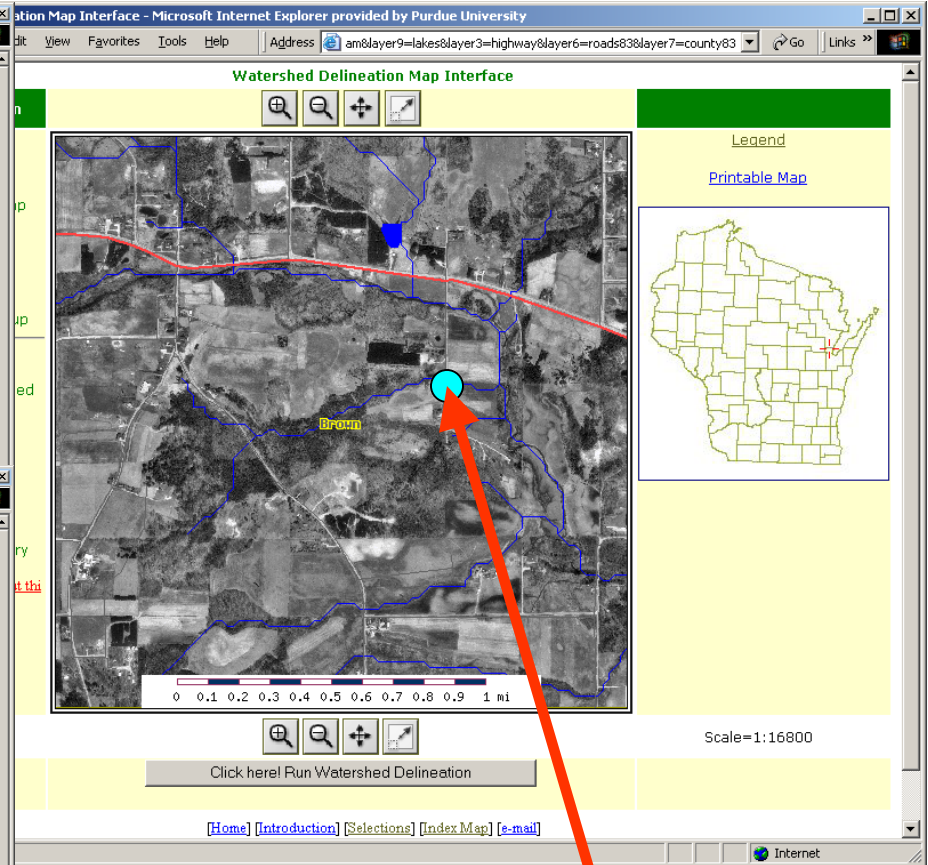
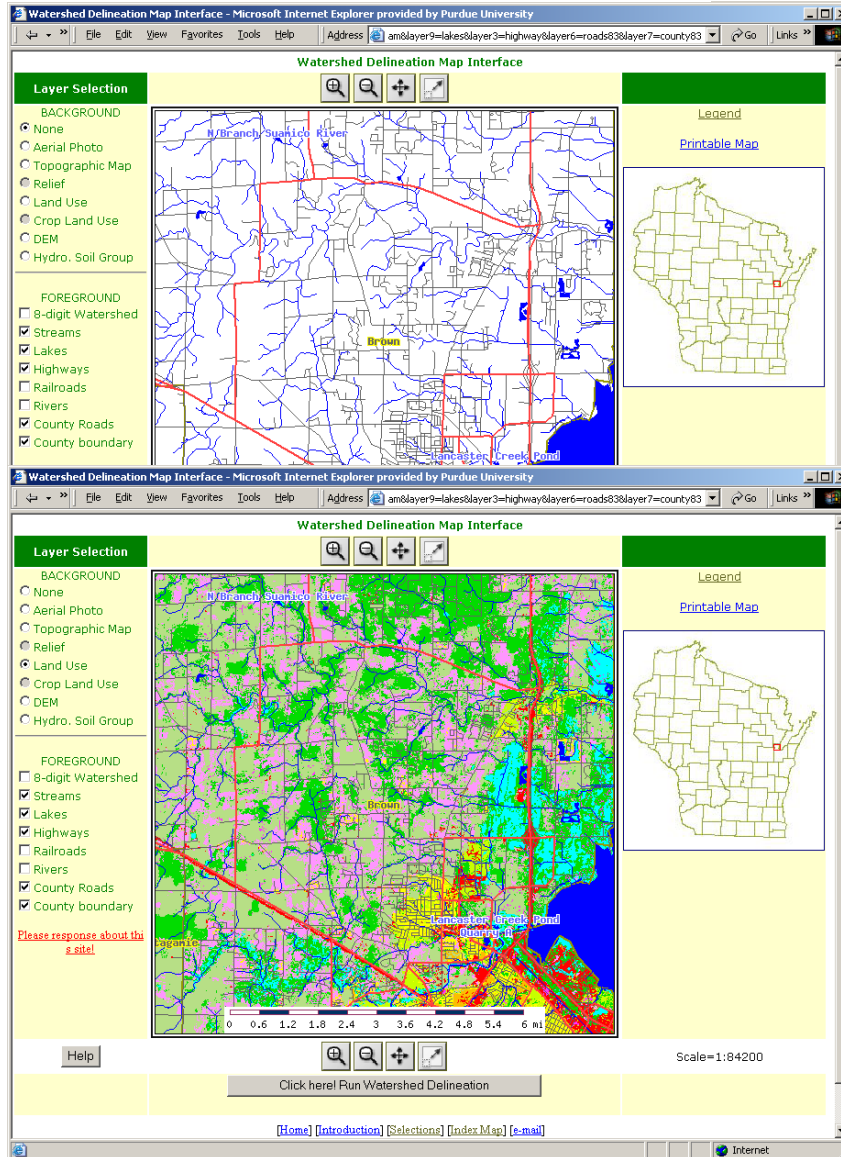
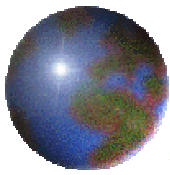
Click here! Run Watershed Delineation

[\[Home\]](#) [\[Introduction\]](#) [\[Selections\]](#) [\[Index Map\]](#) [\[e-mail\]](#)

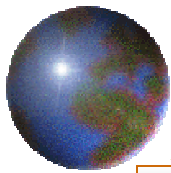
WD Submit Button

Layer
Control
On/Off

Display Control
Zoom in/out
Pan, Full extent



Outlet point selected



Results Page

Queried results for spatial data

Watershed Area (acres)		441.8
Land use	Soil group	Area(acres)
Agriculture	A	2.4
Agriculture	B	140.7
LD-Residential	B	0.9
Grass/Pasture	A	9.6
Grass/Pasture	B	98.8
Forest	A	5.1
Forest	B	184
Total Area		441.6

Watershed maps

If you want to review the maps extracted,

[click here to change land use in your watershed and to see the Mapserver GIS display](#)

If you want to download the maps extracted, click link below

[Download Page](#)

Land use and Hydrologic Soil Group data were prepared, so you can conduct long-term hydrologic impact analysis (L-THIA) for the watershed. Click the button named "Data preparation and run L-THIA", and a completed L-THIA form for running the L-THIA model will be displayed. In a similar manner, you can estimate peak runoff rate from the watershed using SEDSPEC. You can also estimate the amount of impervious area in your watershed.

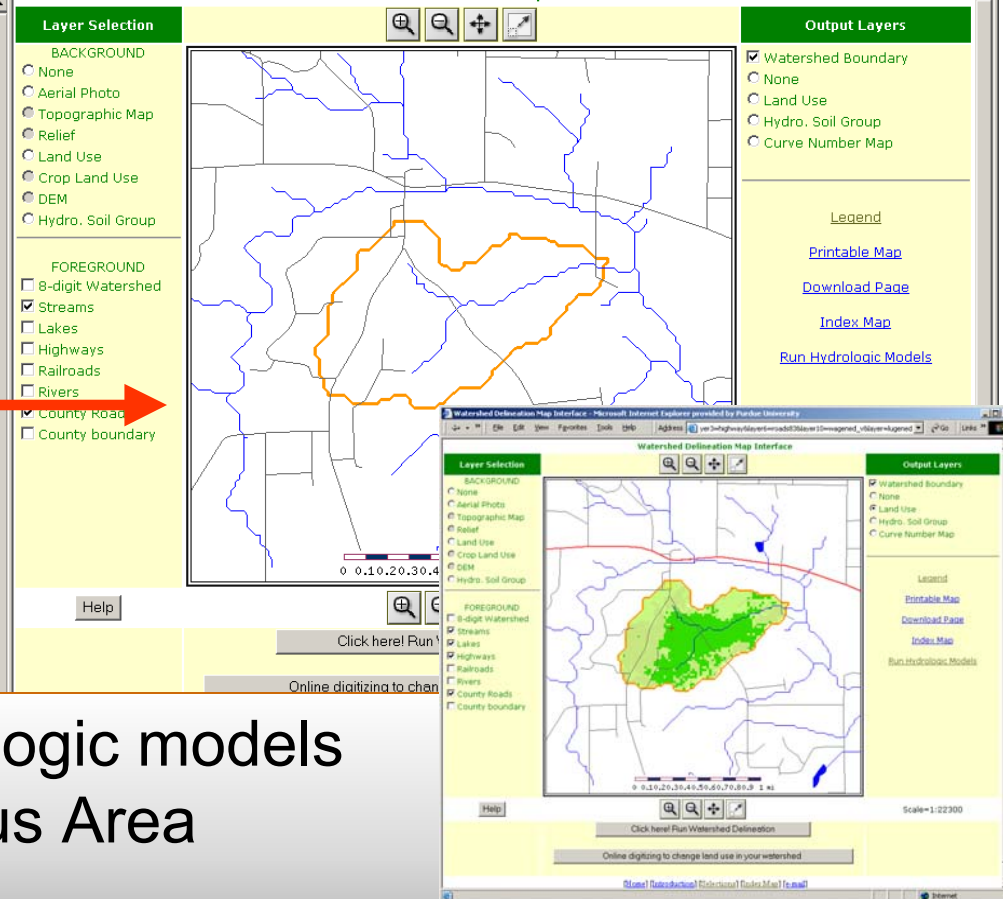
Calculate watershed % of Impervious area

Data preparation and Run L-THIA

Run SEDSPEC for Erosion Control Structures Design

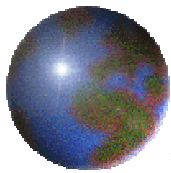
Run Peak Runoff Estimation using SEDSPEC

Result display



Run hydrologic models

- Impervious Area
- L-THIA
- SEDSPEC
- Peak Runoff Estimation



Queried results for spatial data

Watershed Area (acres)	
Land use	Soil group
Agriculture	A
Agriculture	B
LD-Residential	B
Grass/Pasture	A
Grass/Pasture	B
Forest	A
Forest	B
Total Area	

Watershed maps

If you want to review the maps extract

[click here to change land use in your watershed](#)
[the Mapserver GIS display](#)

If you want to download the maps extract
below

[Download Page](#)

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Calculate watershed % of Impervious area

Data preparation and Run L-THIA

Run SEDSPEC for Erosion Control Structures Design

Run Peak Runoff Estimation using SEDSPEC

L-THIA Basic Input

• Name to identify output:

wdcjy8621

• State :

Wisconsin

• County :

Brown

• Area in :

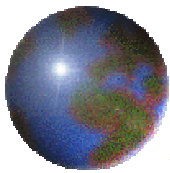
acres

LAND USE	HYD. SOIL GROUP	1	2	3
		SCENARIO 1	SCENARIO 2	SCENARIO 3
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Agricultural	B	140.0		
Low Density Residential	B	0.9		
Grass/Pasture	A	9.1		
Grass/Pasture	B	97.8		
Forest	A	5.1		
Forest	B	184.0		
SELECT LANDUSE	A			
SELECT LANDUSE	A			
SELECT LANDUSE	A			
SELECT LANDUSE	A			
Total Area		439.4	0	0

Data Preparation and Run L-THIA

RUN L-THIA

[Back to Watershed Delineation](#)



Tables and charts for interpretation

L-THIA output - Microsoft Internet Explorer provided by Purdue University
 Address http://pasture.e

L-THIA OUTPUT

Scenario Name : wdcjy8621
 Total area : 439.4 acres
 State : Wisconsin
 County : Brown

Link To [GIS RAINFALL DATA](#) Text File

Average Annual Runoff Volume for SCENARIO 1

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Pasture	B	97.8	3.57
Forest	A	5.1	0.00
Forest	B	184.0	3.51
Total Annual Volume (acre-ft)			26.95
Average Annual Runoff Depth (in)			0.73

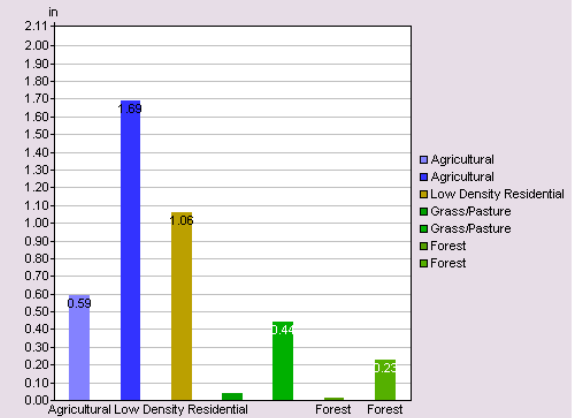
Runoff Depth For Hydrologic Soil Group And Landuse Combination

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Grass/Pasture	A	39	0.04
Grass/Pasture	B	61	0.44
Forest	A	30	0.01
Forest	B	55	0.23

Average Annual Rainfall Depth (in)

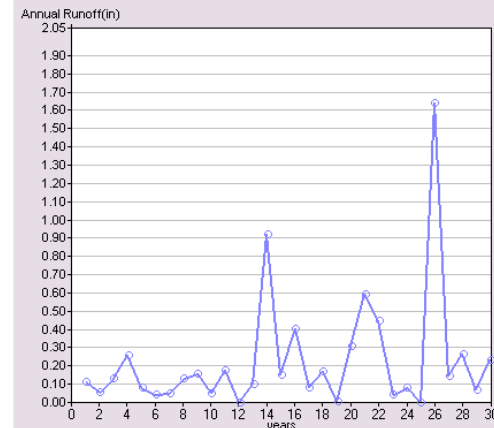
32.15

Runoff Depth



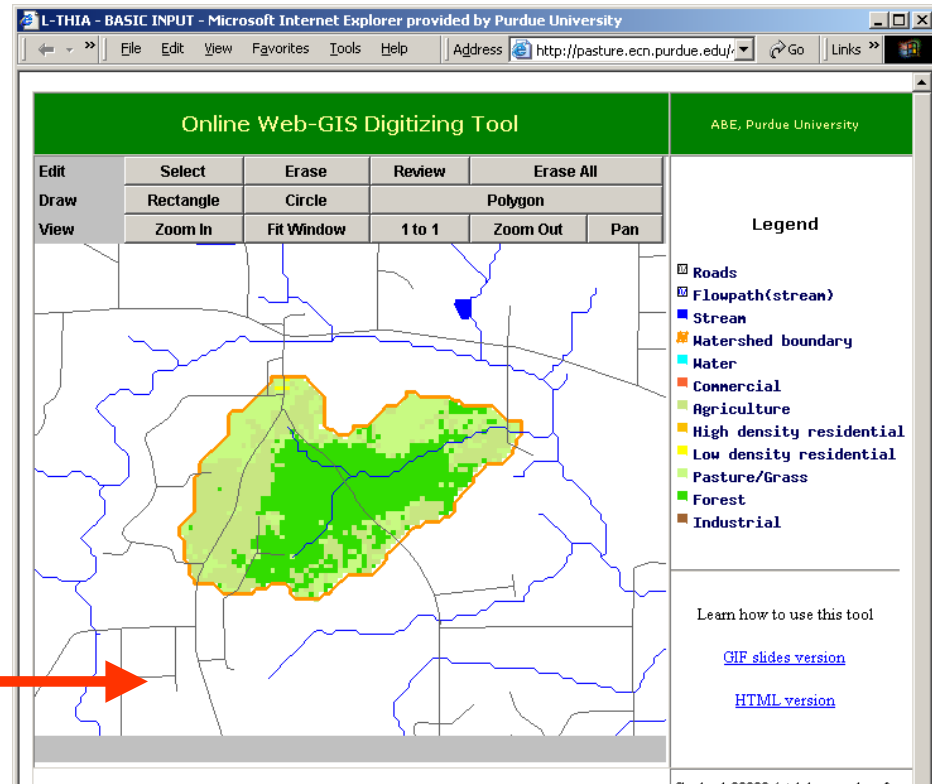
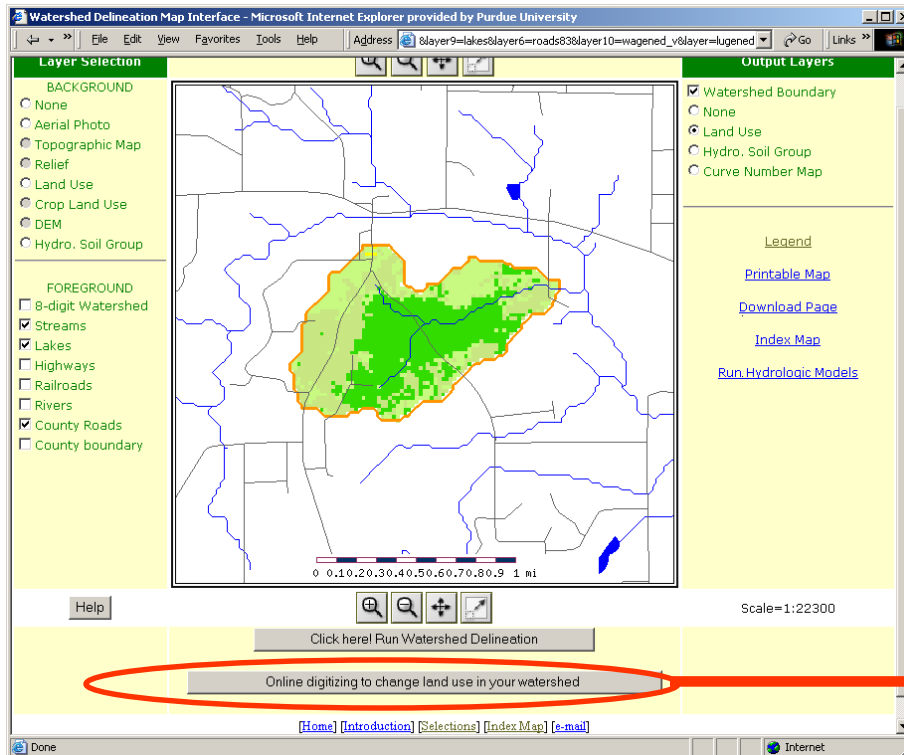
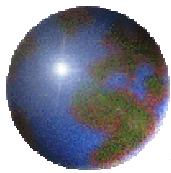
Untitled Document - Microsoft Internet Explorer provided by Purdue University

Annual Variation

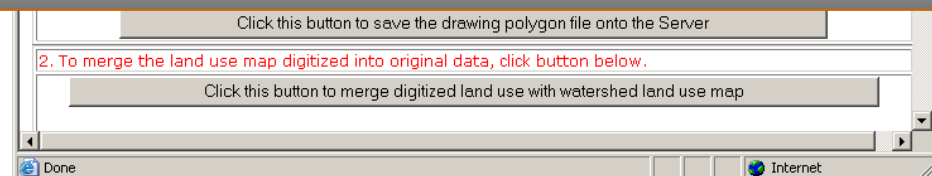


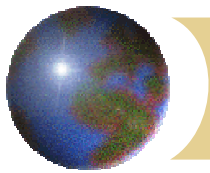
Close

Print Results



Land Use Change Using On-line Digitizing Tool and Run L-THIA





Land Use Change Using On-line Digitizing Tool and Run L-THIA

L-THIA - BASIC INPUT - Microsoft Internet Explorer provided by Purdue University

Address: <http://pasture.ecn.purdue.edu/>

Online Web-GIS Digitizing Tool

ABE, Purdue University

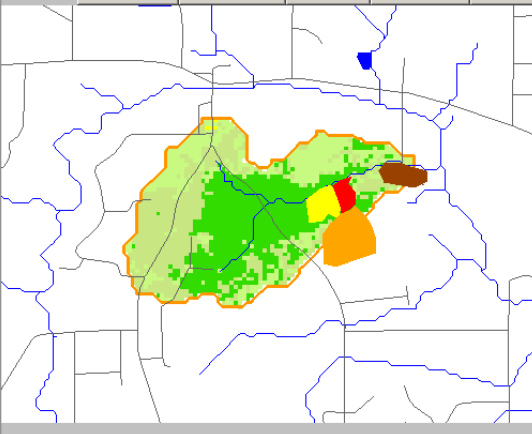
Edit
Draw
View

Select
Rectangle
Zoom In

Erase
Circle
Fit Window

Review
Polygon
1 to 1
Zoom Out

Erase All
Pan



Legend

- ☐ Roads
- ☐ Flowpath(stream)
- ☐ Stream
- ☐ Watershed boundary
- ☐ Water
- ☐ Commercial
- ☐ Agriculture
- ☐ High density residential
- ☐ Low density residential
- ☐ Pasture/Grass
- ☐ Forest
- ☐ Industrial

Learn how to use this tool

[GIF slides version](#)

[HTML version](#)

Scale=1:22200 (at 1:1 zoom level)

1. Click this button first to save the drawing.

Click this button to save the drawing polygon file onto the Server

2. To merge the land use map digitized into original data, click button below.

Click this button to merge digitized land use with watershed land use map

Land Use Change Using On-line Digitizing Tool

Queried results for spatial data - Microsoft Internet Explorer provided by Purdue University

Address: <http://pasture.ecn.purdue.edu/>

Land use data before digitizing		
Land use	Soil group	Area(acres)
Agriculture	A	2.4
Agriculture	B	140.7
LD-Residential	B	0.9
Grass/Pasture	A	9.8
Grass/Pasture	B	99
Forest	A	5.1
Forest	B	184
Total Area		442.1

Land use data inside the watershed after digitizing		
Land use	Soil group	Area(acres)
Commercial	B	8.3
Agriculture	A	2.4
Agriculture	B	129.1
HD-Residential	B	10.6
LD-Residential	B	16.3
Grass/Pasture	A	9.8
Grass/Pasture	B	96
Forest	A	5.1
Forest	B	156.5
Industrial	B	7.9
Total Area		442.1

Land use data outside the watershed after digitizing		
HD-Residential	B	23.9
Industrial	B	5.9
Total Area		30.1

Digitized area maps

If you want to review the maps modified from online digitizing,

[click here to see the Mapserver GIS display](#), and to change land use again.

Land Use Change Report after Digitizing

the L-THIA model will be displayed. In a similar manner, you can estimate peak runoff rate from the watershed using SEDSPEC. You can also estimate the amount of impervious area in your digitized area.

Calculate watershed % of Impervious area

Data preparation and Run L-THIA



Land Use Change Using On-line Digitizing Tool and Run L-THIA

Queried results for spatial data - Microsoft Internet Explorer provided by Purdue University

Address: <http://pasture.ecn.purdue.edu/>

Land use data before digitizing		
Land use	Soil group	Area(acres)
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Calculate watershed % of impervious area

Data preparation and Run L-THIA

Basic Input - Microsoft Internet Explorer provided by Purdue University

Address: <http://pasture.ecn.purdue.edu/~watergen/owls/outputfig/wdcjy8628>

L-THIA Basic Input

• Name to identify output:

• State :

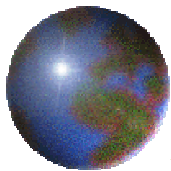
• County :

• Area in :

LAND USE	HYD. SOIL GROUP	1	2	3
Agricultural	A	2.4	2.4	
Agricultural	B	140.7	129.1	
Low Density Residential	B	0.9	16.3	
Grass/Pasture	A	9.8	9.8	
Grass/Pasture	B	99.0	96.0	
Forest	A	5.1	5.1	
Forest	B	184.0	156.5	
Commercial	B		8.3	
High Density Residential	B		10.6	
Industrial	B		7.9	
SELECT LANDUSE	A			
SELECT LANDUSE	A			
SELECT LANDUSE	A			
SELECT LANDUSE	A			
Total Area		442.1	442.1	0

Scenario 1:
Before Change

Scenario 2:
After Change



Results Interpretation

L-THIA output - Microsoft Internet Explorer provided by Purdue University

Address: <http://pasture.ecn.purdue.edu/~sp>

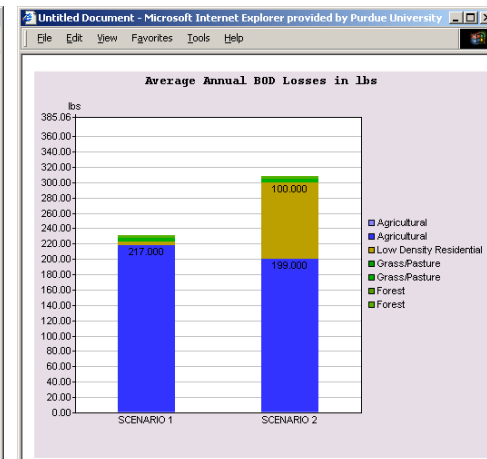
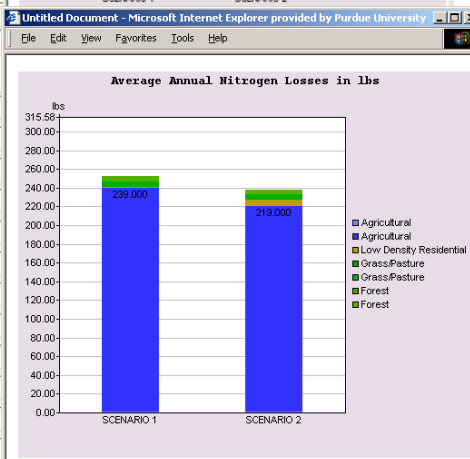
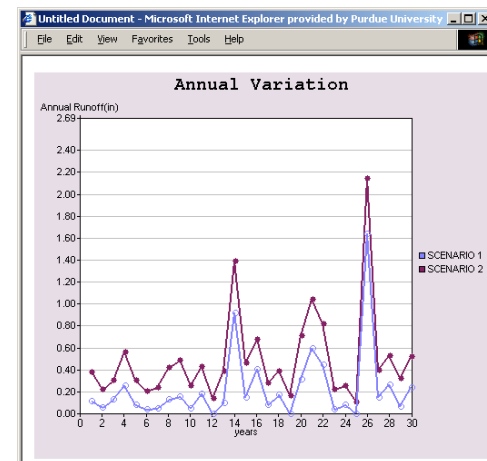
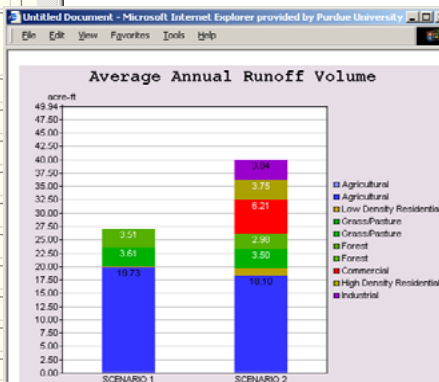
Reload Data
Previous Results
Save Output
Output
Runoff NPS
What Can I Do?

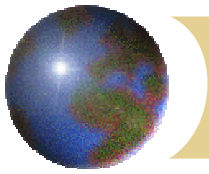
Average Annual Runoff Volume for SCENARIO 1

Land Use	Hydrologic Soil Group	Area (acres)	Average Annual Runoff Volume (acre-ft)
Agricultural	A	2.4	0.11
Agricultural	B	140.7	19.73
Low Density Residential	B	0.9	0.07
Grass/Pasture	A	9.8	0.03
Grass/Pasture	B	99.0	3.61
Forest	A	5.1	0.00
Forest	B	184.0	3.51
Total Annual Volume (acre-ft)			27.09
Average Annual Runoff Depth (in)			0.73

Average Annual Runoff Volume for SCENARIO 2

Land Use	Hydrologic Soil Group	Area (acres)	Average Annual Runoff Volume (acre-ft)
Agricultural	A	2.4	0.11
Agricultural	B	129.1	18.10
Low Density Residential	B	16.3	1.43
Grass/Pasture	A	9.8	0.03
Grass/Pasture	B	96.0	3.50
Forest	A	5.1	0.00
Forest	B	156.5	2.98
Commercial	B	8.3	6.21
High Density Residential	B	10.6	3.75
Industrial	B	7.9	3.84
Total Annual Volume (acre-ft)			40.01
Average Annual Runoff Depth (in)			1.08





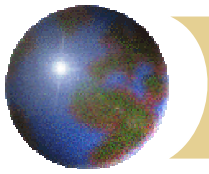
Important Questions

(we know they are important because.....)

Cost: There is no software or site access cost. \$0, honest!
(Your tax dollars at work – thanks to EPA Region V)

Knowledge / Technical Expertise: Basic Version: Middle school teachers use this with their students.

Data: Basic data for WI is online – you can start with nothing. You can use your own land use data and can create custom calibrated land uses, and change the pollutant loadings (or add new pollutants) to improve match to local data.

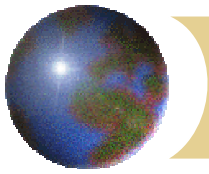


Important Questions

Staff: No commitment for user.

Platform: Basic and Custom Version: Internet Access.
You can run a GIS version if you like.

Validity: Consistent with empirical data and other models.
Accuracy increases with local calibration.

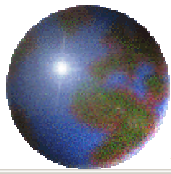


Important Questions

Transparency: If you've forgotten, it's all explained at the web site.

Understandability: Tool produces average annual runoff and pollutant loadings for each land use decision.


Scope: Can be used at site or broad scale, but should be used at the scale of the land use decision.



Impacts of Land Use Change on Water Resources - Microsoft Internet Explorer provided by Purdu...

File Edit View Favorites Tools Help Address <http://www.e> Go Links

Impacts of Land Use Change on Water Resources



[Home](#)
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 [Advanced Input](#)
 [Impervious Input](#)

[Previous Results](#)

[L-THIA GIS](#)
[SedSpec](#)

[Web-GIS Tools](#)

[Determining Short-term Impacts](#)
The short-term impacts of a change in land use can often be

[Determining Long-term Impacts](#)
The long-term impacts of a change in land use can often be seen in the **average**

**Changing Landscapes:
Anticipating the effects of
local land use decisions.**

Long-Term Hydrological Impact Assessment (L-THIA)